

## KEY TO FIRST AND SECOND INSTARS OF SIX SPECIES OF COCCINELLIDAE (COLEOPTERA) FROM ALFALFA IN SOUTHWEST VIRGINIA

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*Abstract.*—A key is given that allows identification of either live or alcohol preserved first and second instars of *Coccinella septempunctata* Linnaeus, *Coleomegilla maculata* (De Geer), *Cycloneda munda* (Say), *Harmonia axyridis* Pallas, *Hippodamia convergens* Guerin, and *H. parenthesis* (Say). These six species are the most commonly collected Coccinellidae in alfalfa fields in Montgomery County, Virginia. The main emphasis in this key is on the relative placement and characteristics of the most prominent setae on the tergum of the abdomen. This is the first key ever written specifically for early instars, and the first that does not rely on color patterns of live larvae.

*Key words:* Coccinellidae, identification, key, larvae, alfalfa, Virginia.

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Keys for identifying larvae of Coccinellidae have traditionally been based on the morphology of the final instar. One of the most comprehensive keys for North American genera was published recently by Rees et al. (1994). It included several species, but was restricted to late instar larvae. This reliance on late instar larvae is largely due to the drastic changes in appearance from the first instar to the last. First and second instars usually lack the color patterns and the distinctive setal armature that often characterize third and fourth instars.

Although Palmer (1914) did not provide a key, she did describe some early instars of eight species of Coccinellidae from Colorado. Her brief descriptions refer mainly to color patterns, and not all first and second instars are individually described. Strouhal (1927) included more detail, noting both color patterns and basic descriptions of setae for first, second, and third instars of 17 Palearctic species. His key does not distinguish one instar from another. Storch (1970) made a significant contribution to knowledge of early instar larvae of North American Coccinellidae when he gave basic descriptions, also based on color patterns of living larvae, for all instars of five species found in potato fields in Maine. He prepared a key to larvae of those species, but the key does not sort one instar from another, nor is it useful for any of the first instars or the second instar of *Adalia bipunctata* (Linnaeus) because, according to his observations, these instars lacked any color variation.

Not everyone is fortunate enough to have living larvae when making identifications. Often the only specimens available have been preserved in alcohol, and although it is sometimes still possible to distinguish light from dark areas on such specimens, most true colors are not discernible. Therefore, characters other than color are necessary for identification. The key presented here is a new approach because it relies heavily on setal characteristics, and does not depend on color. It

will separate first and second instars, either living or alcohol preserved specimens, for six species of Coccinellidae commonly found in alfalfa in southwest Virginia—*Coccinella septempunctata* Linnaeus, *Coleomegilla maculata* (De Geer), *Cycloneda munda* (Say), *Harmonia axyridis* Pallas, *Hippodamia convergens* Guerin, and *H. parenthesis* (Say).

#### METHODS

Larvae were reared from known adults of these six species, then first and second instars were examined and compared to find distinguishing characters. All specimens used in the preparation of this key are preserved in alcohol and are housed in the author's department. In the interest of making the key useful to a wide audience, technical terminology has been kept to a minimum. One term which is necessary when referring to setal structures is parascolus. It is used here as defined by Gage (1920), i.e., a projection of the body wall that is usually two, and not more than three, times as long as wide, and that bears a few short branches, each with a seta at the tip. Good illustrations of various types of setal armature of larval Coccinellidae, including a parascolus, can be found in Rees et al. (1994). However, illustrations in that publication were made from late instar larvae. In second instar larvae parascoli are much less pronounced, and they are not present in any first instar larvae of the six species described here.

The shape of the claw is important in distinguishing some species, but cannot be relied on in other species because the appearance changes from early to late instars. For example, both *H. axyridis* and *C. munda* have a claw with a definite rectangular base that is easy to see from the first to the fourth instar. In contrast, the rectangular claw base of *C. septempunctata* is not apparent in the first instar, but can be distinguished beginning with the second instar. Van Emden (1949) noted this fact in his key in the couplet that separates out the genus *Coccinella*. The simple hook-shaped claws of *H. convergens*, *H. parenthesis*, and *C. maculata* remain the same through all instars.

The most commonly used characters in this key are on the tergum of the abdomen. The convention of calling the setal areas on the dorsal abdominal tergum "lobes," and referring to them as dorsal, dorsolateral, and lateral is adopted here for simplicity, as it has been by Storch (1970) and Gordon and Vandenberg (1991, 1993). These lobes have been abbreviated in the key as: D = dorsal lobes; DL = dorsolateral lobes; L = lateral lobes. The relative placement and characteristics of the most prominent setae on these lobes help distinguish each species. A purely diagrammatic representation of the setal patterns of the most prominent setae on the dorsal lobes, and for *H. axyridis* the dorsolateral lobes, is shown in Fig. 1. The pattern is the same for *H. convergens* and *H. parenthesis*.

Annotations that appear in brackets [] after a couplet give supplemental information that may help in making a determination, but that cannot be used to unambiguously distinguish among taxa or instars.

Color patterns of the dorsal abdominal lobes have been included in this key as "light" or "dark" only. Table 1 is a schematic representation of these color patterns so that all six species can be compared at a glance.

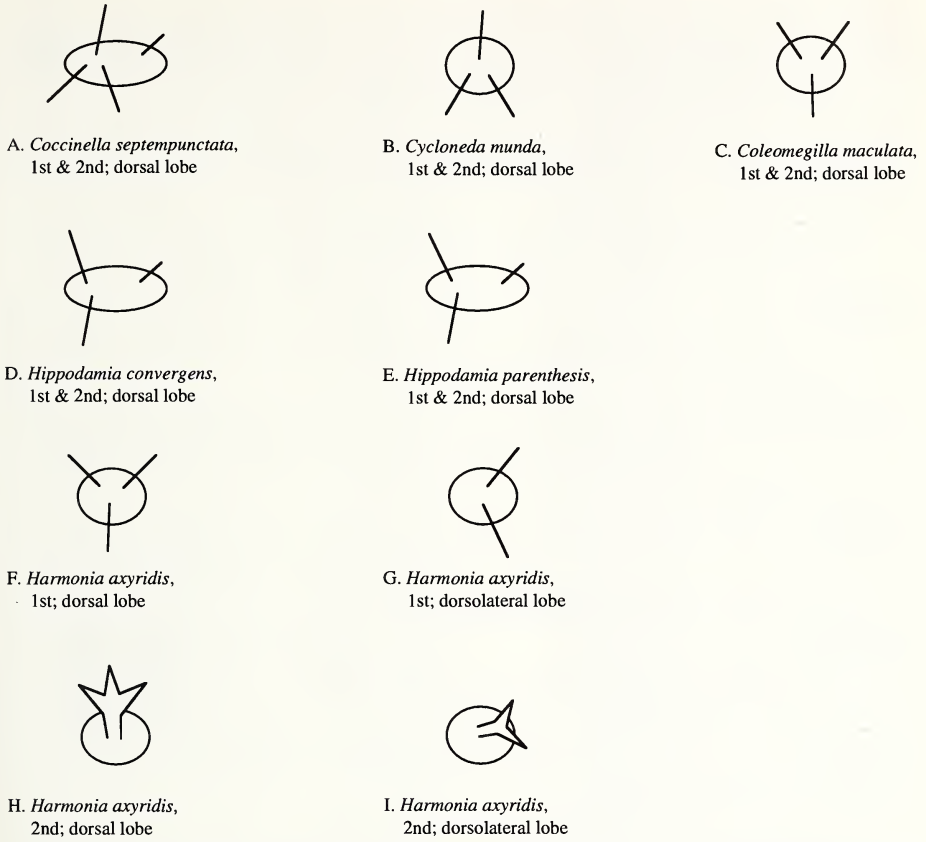


Fig. 1. Diagrammatic representation of setal patterns of the most prominent setae on the dorsal and dorsolateral lobes of first and second instars of six species of coccinellids. Setae are not drawn to scale, so widths and lengths cannot be compared. The type of base is not indicated, nor are any of the less conspicuous setae.

KEY TO FIRST AND SECOND INSTAR LARVAE

- 1. D with 3 setae or spines, DL with 2 setae or spines (Fig. 1, F-I); pronotum heavily sclerotized, with the appearance of one solid plate, and with stout projections rather than individual setae (except in very early 1st instars, which have individual setae on pronotum); claw with definite rectangular base . . . . . 2
- Both D and DL with 3 or more setae; sclerotization of pronotum variable, but not as one solid plate; pronotum with individual setae; claw variable . . . . . 3
- 2. D and DL with stalked bi- and tri-forked spines rather than setae (Fig. 1, H & I), only DL of first abdominal segment light (some trace of light color may be seen in other DL lobes extending posteriorly from 1st segment in older 2nd instars), rest of lobes dark (Table 1) . . . . . *Harmonia axyridis*, 2nd instar
- D and DL with stout, prominent dark setae, not forked at tip (Fig. 1, F & G); all lobes uniform in color (Table 1) . . . . . *Harmonia axyridis*, 1st instar

Table 1. Pattern of light and dark lobes on the first through fourth dorsal abdominal segments for first and second instars of six species of coccinellids. X = dark lobe; O = light lobe. Space between letters represents midline of dorsum, so beginning from left, lobes are as follows: L, DL, D (left side of body), then D, DL, and L (right side).

| Species                          | 1st instar | 2nd instar    | early 2nd instar |
|----------------------------------|------------|---------------|------------------|
| <i>Coccinella septempunctata</i> | XXX XXX    | OOX XO0 (1st) |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX (4th) |                  |
| <i>Coleomegilla maculata</i>     | OOX XO0    | OOX XO0       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | OOO OOO    | OOO OOO       |                  |
| <i>Cycloneda munda</i>           | OOX XO0    | OOX XO0       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | OOO OOO       |                  |
| <i>Harmonia axyridis</i>         | XXX XXX    | XOX XOX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
| <i>Hippodamia convergens</i>     | OOX XO0    | OOX XO0       | OOX XO0          |
|                                  | XXX XXX    | XXX XXX       | XXX XXX          |
|                                  | XXX XXX    | XXX XXX       | XXX XXX          |
|                                  | XXX XXX    | OOX XO0       | XOX XO0          |
| <i>Hippodamia parenthesis</i>    | OOX XO0    | OOX XO0       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | XXX XXX    | XXX XXX       |                  |
|                                  | OOX XO0    | OOX XO0       |                  |

3. D with only 3 prominent dark setae, widely and equidistantly spaced, 2 anteriorly and 1 posteriorly (Fig. 1, C) [arising from broad rounded areas of derm]
  - D with 3 or 4 prominent setae; either not equidistantly spaced, or, if so, then only 1 long seta anteriorly and 2 posteriorly . . . . . 5
4. Pronotum with light spot on anterior, outer corner; L with 2 prominent long, dark, stout setae, along with several shorter, fine setae [claw hook-shaped; color pattern: DL and L light on 1st abdominal segment; all lobes light on 4th (Table 1)] . . . . .
  - Pronotum without light spot; L with only 2 prominent dark, stout setae, one longer than the other [claw hook-shaped; color pattern: DL and L light on 1st; all lobes light on 4th (Table 1)] . . . . . *Coleomegilla maculata*, 2nd instar
  - *Coleomegilla maculata*, 1st instar
5. D with 3 prominent dark, stout setae, about equal in length and equidistantly spaced, 1 anteriorly and 2 posteriorly, plus 1 shorter, dark, stout seta laterad to the three (Fig. 1, A) . . . . . 6
  - D with 3 prominent setae, not stout but fine, clear or brown; if other shorter setae are present, they are fine and clear, not stout and dark . . . . . 7
6. D and DL with several fine, short setae in addition to prominent long, stout, dark

- setae; setae arising from short parascoli [color pattern: DL and L light on 1st, all lobes dark on 4th (Table 1)] . . . . . *Coccinella septempunctata*, 2nd instar
- D and DL with dark stout setae only; setae arising from surface of integument, not from parascoli [color pattern: all lobes uniform in color (Table 1)] . . . . .  
 . . . . . *Coccinella septempunctata*, 1st instar
7. Claw with obvious rectangular base; D with 3 prominent long, brown, fine setae (other shorter setae may be present also), widely and equidistantly spaced and about equal in length (Fig. 1, B); setae arising from broad, rounded areas on integument . . . . . 8
- Claw hook-shaped; D with 3 prominent setae (other shorter setae may be present also), 2 medial and 1 laterad (Fig. 1, D & E); setae of unequal lengths, clear or light brown, arising from raised bases or parascoli . . . . . 9
8. L with 2 long, fine setae, ca. equal in length; D with only 3 prominent long, brown setae [color pattern: DL and L light on 1st; all lobes dark on 4th (Table 1)] . . . . .  
 . . . . . *Cycloneda munda*, 1st instar
- L with several fine setae of varying lengths; D with several setae besides the 3 prominent ones [legs long, 1st pair longer than the other two, tibia longer than femur; color pattern: DL and L light on 1st; all lobes light on 4th (Table 1)] . . . . .  
 . . . . . *Cycloneda munda*, 2nd instar
9. L with setae of varying lengths, longest one not twice length of any other; length of front femur half to  $\frac{2}{3}$  the width of pronotum (in 1st instar length may = width of pronotum); setae clear, very fine . . . . . 10
- L with 1 prominent seta, if other setae are present, main one is ca. twice as long as any other; length of front femur ca. equal to or > width of pronotum; setae either brown or clear, stiff, like bristles . . . . . 11
10. L with only 3 setae of different lengths [color pattern: DL and L light on both 1st and 4th (Table 1)] . . . . . *Hippodamia parenthesis*, 1st instar
- L with other setae in addition to 3 prominent ones, of various lengths [color pattern: DL and L light on both 1st and 4th lobes (Table 1)] . . . . .  
 . . . . . *Hippodamia parenthesis*, 2nd instar
11. L with only 1 seta [color pattern: DL and L light on 1st; all lobes dark on 4th (Table 1)] . . . . . *Hippodamia convergens*, 1st instar
- L with 1 prominent long seta but several other shorter setae also present; [color pattern: DL and L light on 1st; on 4th segment variable, from some color on DL to both DL and L light (Table 1)] . . . . . *Hippodamia convergens*, 2nd instar

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